GROUNDWATER OF WESTERN SPRINGFIELD

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(Parker, Rechin, and Wilder, 1979)

Groundwater touches everyone's existance in one form or another. In 1970, groundwater supplied 19% of the total water use in the United States (Freeze and Cherry, 1979). In the home it is used for washing, cooking, etc. The farmer uses it for irrigation and livestock. Industries use it in production and for cooling. Virtually every facet of our daily lives are connected to groundwater in one way or another.

But groundwater isn't some infinite, uncorruptable, cornucopia, it too can be harmed or destroyed by abuse. The sinkholes in Florida are the result of over-use of the groundwater. Many communities across the country are forced to have water piped in because they drained or polluted their aquifer. Contamination can be caused by acid mine drainage, over-use of pesticides, or a poorly installed leach bed. Some create a nuisance, others can be a health hazard. Contaminants can appear miles from their source. It is necessary to know where the potential sources of pollution are, and be able to plan for and around them.

AREA HISTORY

Springfield, as its name implies, was founded in an area of good groundwater and plentiful springs. The first inhabitant of the area, James Demint, chose the location for its springs and limestone, (building material). More inhabitants and the subsequent wells lowered the water table so that there are few springs and flowing wells in the area today (Prince, 1901). Currently, groundwater supplies nearly all of the area's water.

AREA GEOLOGY

The bedrock of the area is the Silurian age Niagra limestone. The uppermost member is the Cedarville limestone, a massive, porous, indurate limestone, averaging 150 feet thick. Under the Cedarville is the Springfield limestone, a 14-foot thick, thin-bedded, dense dolomite. The beds dip to the northeast at about 15 feet per mile as part of an anticline called the Cincinnatti Arch. (Lemire, 1973)

Pleistocene glaciers covered the area with till. The most recent advance was during the late Wisconsin period, 7,000 to 23,000 years ago. The area west of the Mad River is called the North Hampton Till Plain. This area has several layers of till, indicating multiple advances of ice, followed by retreat and meltwater. The till averages 30 feet thick, and contains lenses of sand and gravel. (Brown, 1948).

WATER QUALITY

Although there are no analyses of the study area's wells, regular tests have been performed on well number 5 of the Springfield Water Works by the United States Geological Survey, (table 1 shows the results) I should mention that the well draws water from the outwash alluvium in the Mad River valley, not the limestone beds of the study area.

The possible sources of the constituents revealed by the water test are mostly natural and non-point, and therefore beyond control. Most are by-products of rock weathering and soil formation. Some, like chlorine, are from biological wastes such as leach beds and plant debris. The high levels of bicarbonates and hardness are from the limestone clasts in the till, and the limestone bedrock (Pettyjohn, 1972).

The effects of these constituent levels vary from negligable to inconvenient. The only four with high enough levels to cause any problem are: iron, dissolved solids, bicarbomates, and hardness. Iron in amounts of more than 0.3 mg/l can stain clothes and porcelain, and give the water a metallic flavor. Dissolved solids can affect the flavor and make filters necessary for industrial use. The bicarbonates and hardness are interrelated, and both are capable of scaling pipes and requiring vast amounts of soap (Pettyjohn, 1972).

The iron and dissolved solids can be removed through filtration, but this is only necessary for industrial use. The bicarbonates and hardness of the local water requires softeners. In fact the phone directory lists 14 softener dealers for Springfield alone.

TEST ITEM*	TEST DATE 6-3-69	11-3-71	5-23-72	11-1-72	6-27-73
Fe	.78	.89	.98	.88	.32
Na	5.5	5.8	8.7	9.2	10
Mn	.14	.12	---	.20	.11
Cl	13	16	21	20	24
NITRATE (NO_3)	5.1	2.9	3.8	3.9	2.4
SULFATE (SO_4)	99	89	99	97	100
BICARBONATE (HCO_3)	364	362	356	344	320
DISSOLVED SOLIDS	500	462	480	452	434
CARBONATE HARDNESS	404	410	410	400	390
NON-CARBONATE HARDNESS	106	110	120	120	130
pH	7.4	7.4	7.8	8.2	7.5

TABLE 1

*units are mg/l

(From USGS tests of well #5 of the Springfield Water Works)

AQUIFERS

There are two aquifers in the study area; glacial lenses, and limestone beds. The lenses of gravel and sand in the till yield around 3800 l/min. These aquifers are used for irrigation. The majority of the domestic wells in the study area are using the limestone beds, especially the Cedarville limestone. This formation yields an average of 450 l/min, and is so indurate that there is no need for either a screen or a gravel pack (Norris, 1952)

SURFACE WATER

There is a small stream on the eastern edge of the study area called Rock Run. It averages 50 cm wide, 19 cm deep, with an estimated velocity of 12 cm/sec. These figures yield an average discharge of 11,400 cm^3/sec, or 11.4 l/sec, (about 3 gal/sec). There is a second stream shown on the map, a small, ephemeral stream located in the south-central portion of the study area. My field observations, however, failed to turn up any kind of a stream bed in the vicinity. I suspect that the farm land has been re-worked since the map was made, and the drainage was altered.

FLOW NET

The flow net of an area is usually somewhat easy to construct. First you measure the hydraulic head at a number of sites. This is done by recording the location, the depth to the water level, and the depth of the well. Then you subtract the the depth to the water level from the ground elevation, (above sea level). The resultant figures, when plotted on a map, give the potentiometric surface, commonly called the water table. Figure 1 is a map of the study area with a set of overlays for the isocontours of the potentiometric surface and the resultant flowlines. Figure 2 is the locations of the test wells, and table 2 gives the data for each well. All information is in feet and inches because the topographic map is in English units.

CONCLUSION

The need for this type of information is vital to some. There are several people in the study area who requested, and will receive, a copy of this report. They want to know where their water is coming from. Do the pesticides of that farmer get into my water? Am I getting water from my own leach bed, or my neighbor's? If I build on this site, how deep will I drill a well, ~~and~~ where should I put it? Simple domestic questions, but important to those who live here.

SITE	CASING HEIGHT ABOVE GROUND (inches)	WATER DEPTH (inches)	TOTAL PIPE LENGTH (inches)	HYDRAULIC HEAD (feet above sea level)
S 1	14	112	531	1036.25
S 2	16	44	540	1030
S 3	10	65	540	1021.25
S 4	10	113	720	1003.25
S 5	16	152	840	994
S 6	14	259	540	989.75
S 7	14	118	484	990
S8	00	144	360	982
V 1	12	96	600	1029
V 2	16	59	540	1022.25
V 3	12	88	900	993.33
V 4	12	40	900	989.33
N 1	11	67	840	986.5
N 2	10	41	720	984.25
N 3	13	64	900	981.42
N 4	11	43	780	969.5
A 1	9	54	900	980.25
A 2	11	56	720	985.58
A 3	18	57	960	986.25
A 4	17	77	600	987.83

TABLE 2

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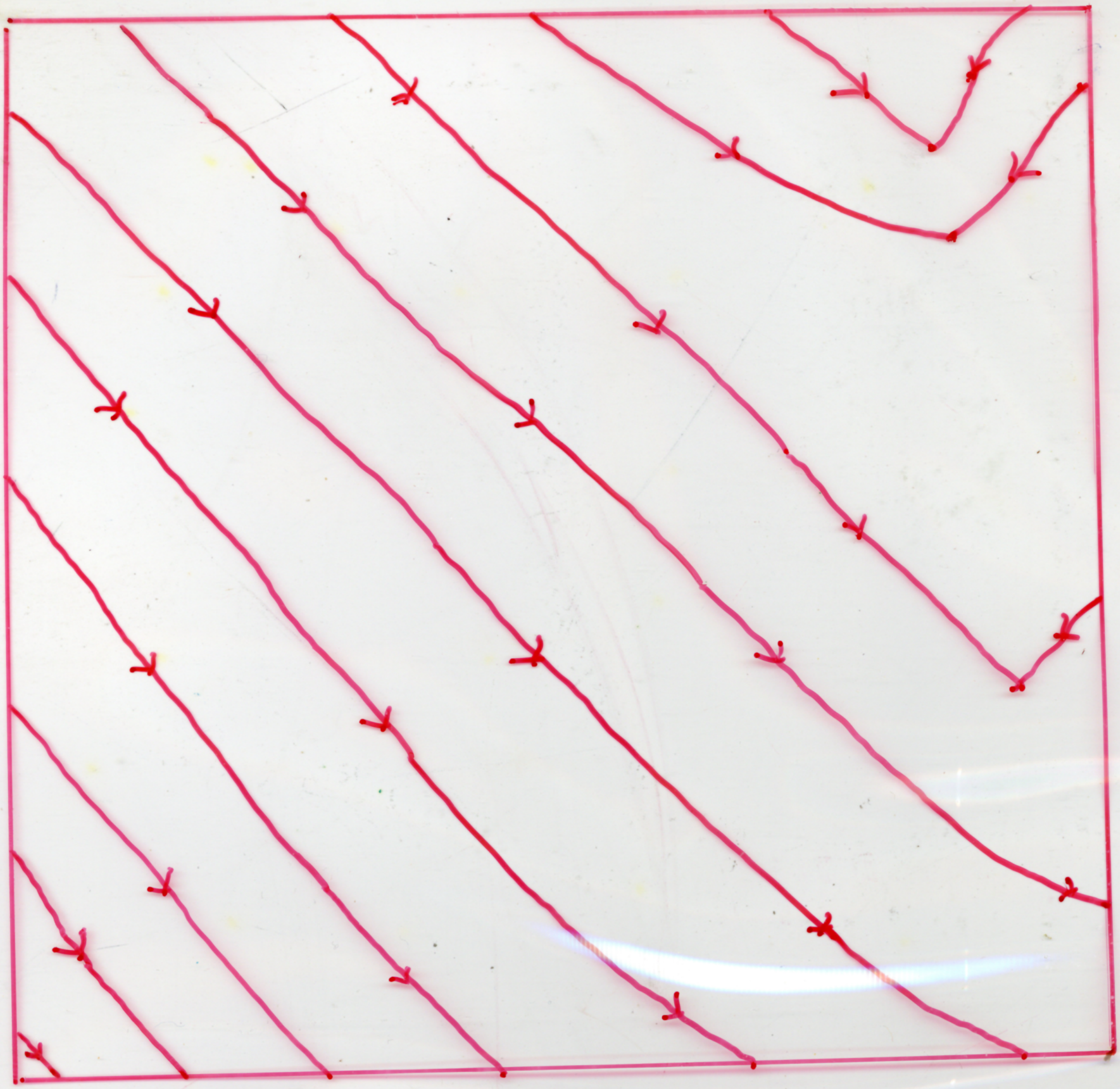
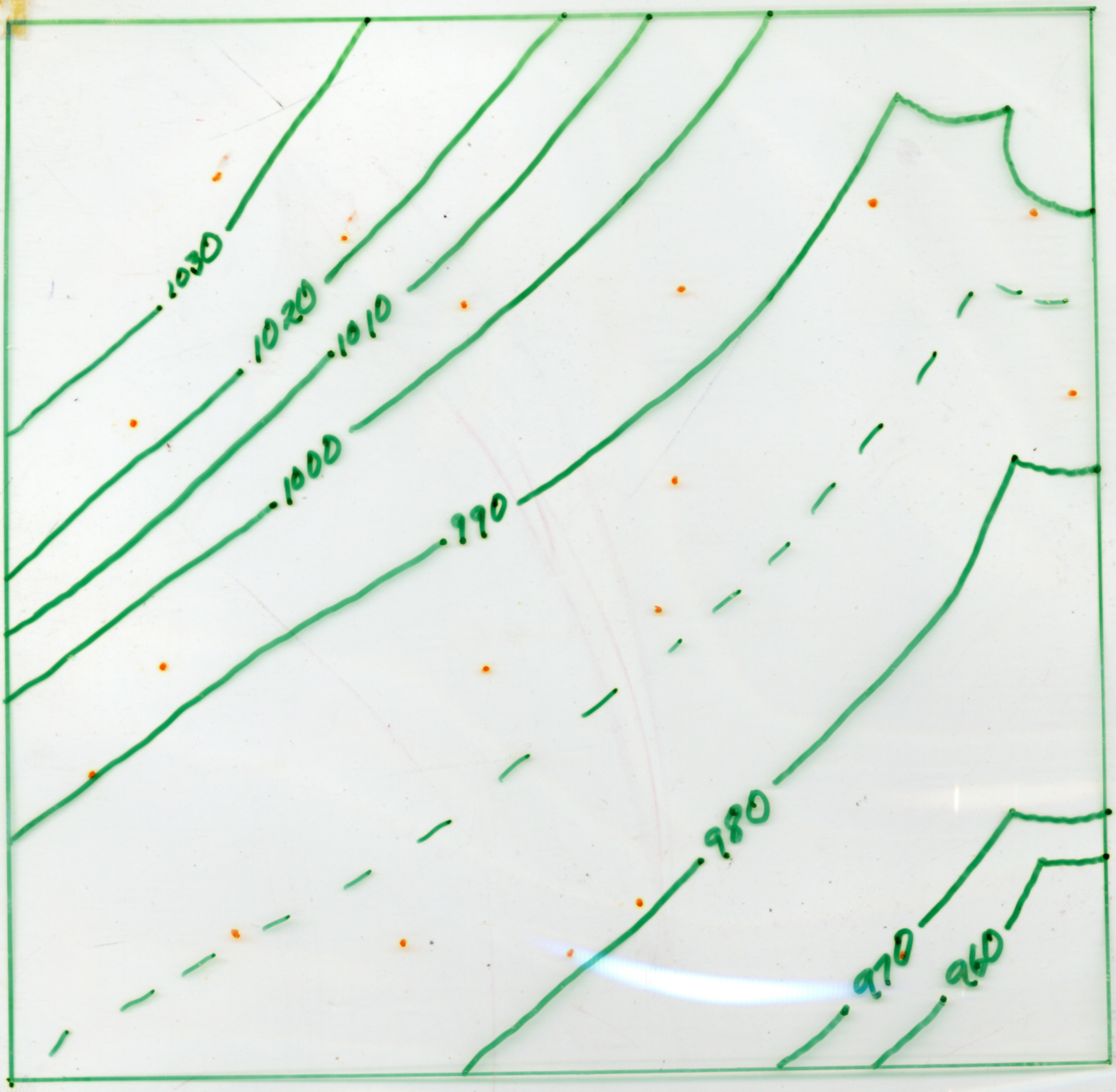
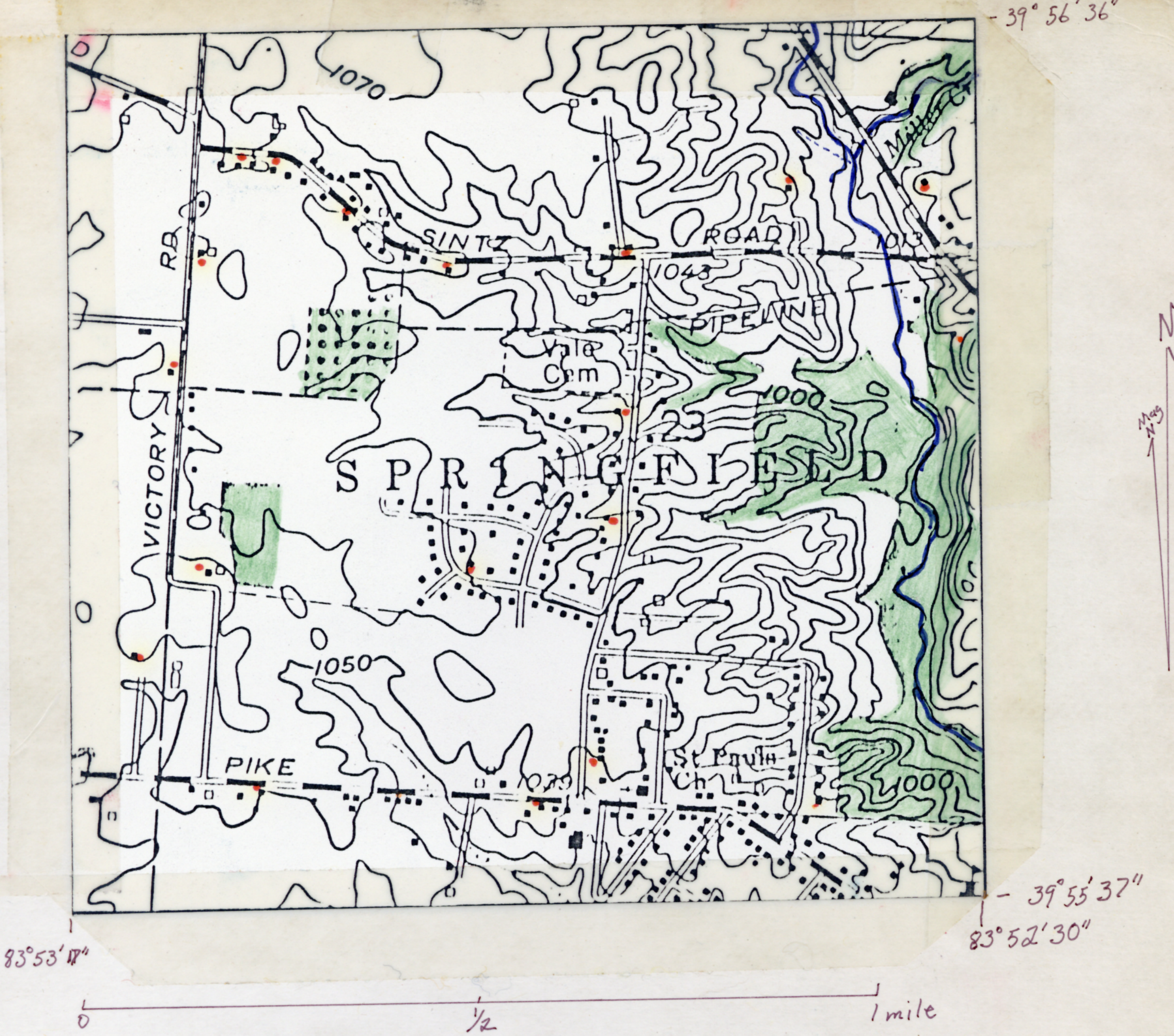


Flow Lines, arrows indicate direction



Isoline of well head



Scale 1:12,000 Contour Interval 10 feet

Datum is Mean Sea Level

· wells sampled

Figure 1

0 1/2 1 mile

Scale 1:12,000 Contour Interval 10 feet

Datum is Mean Sea Level

Isoline of well head

Flow lines, arrows indicate direction

· wells sampled

Figure 1